09/673428

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BIRD, William
Bird Goën & Co.
Vilvoordsebaan 92
B-3020 Winksele
BELGIQUE

Date of mailing (day/month/year)
27 October 2000 (27.10.00)

Applicant's or agent's file reference
S1297-PCT

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/02771

International filing date (day/month/year)
21 April 1999 (21.04.99)

1. The following indications appeared on record concerning:

[ ] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address
BIRD, William
Bird Goën & Co.
Termerestraat 1
B-3020 Winksele
Belgium

State of Nationality:
State of Residence:
Telephone No.: +32-16-48.05.62
Facsimile No.: +32-16-48.05.28
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
BIRD, William
Bird Goën & Co.
Vilvoordsebaan 92
B-3020 Winksele
Belgium

State of Nationality:
State of Residence:
Telephone No.: +32-16-48.05.62
Facsimile No.: +32-16-48.05.28
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

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[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
Lazar Joseph Panakal
Telephone No.: (41-22) 338.83.38

ATENT COOPERATION TRE TY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BIRD, William
Bird Goën & Co.
Termerestraat 1
B-3020 Winksele
BELGIQUE

Date of mailing (day/month/year)
02 October 2000 (02.10.00)

Applicant's or agent's file reference
S1297-PCT

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/02771

International filing date (day/month/year)
21 April 1999 (21.04.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
INNOVATIVE SPUTTERING TECHNOLOGY
N.V.
Karreweg 18
B-9870 Zulte
Belgium

State of Nationality: BE
State of Residence: BE
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[X] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address
N.V. BEKAERT S.A.
Bekaertstraat 2
B-8550 Zwevegen
Belgium

State of Nationality: BE
State of Residence: BE
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
Eugénia Santos
Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 06 December 1999 (06.12.99)	
International application No. PCT/EP99/02771	**Applicant's or agent's file reference** S1297-PCT
International filing date (day/month/year) 21 April 1999 (21.04.99)	**Priority date** (day/month/year) 30 April 1998 (30.04.98)
Applicant LIPPENS, Paul et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

15 November 1999 (15.11.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer C. Cupello
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/02771

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K19/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 849 618 A (NAMIKAWA) 18 July 1989 (1989-07-18)	1-5,10, 15,27, 28,30,31
A	column 1, line 8 - line 11 column 2, line 67 - column 3, line 13 column 3, line 44 - line 62 column 4, line 26 - line 46 column 5, line 8 - line 12 column 7, line 13 - line 25 column 7, line 51 - line 52 column 8, line 63 - column 9, line 11 column 9, line 23 - line 36	9,11
Y	figures 10,11	8,19-23

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 September 1999	10/09/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Thomas, R.M.

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 383 687 A (SUESS) 24 January 1995 (1995-01-24) column 2, line 40 - line 54 column 4, line 36 - line 61 column 5, line 55 - column 6, line 21	8,19-23
A	column 6, last last - column 7, line 45; figure 1 ---	1-3,5, 27,28,31
A	US 5 720 500 A (OKAZAKI) 24 February 1998 (1998-02-24) column 1, line 8 - line 13 column 4, line 21 - line 43 column 5, line 4 - line 15 figure 4 -----	1,5,17, 19,25, 27,28,31

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/02771

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4849618 A	18-07-1989	JP 61248228 A	05-11-1986
US 5383687 A	24-01-1995	AT 139487 T	15-07-1996
		BR 9300682 A	31-08-1993
		DE 4212290 C	27-05-1993
		DE 4242407 A	02-09-1993
		DE 59302961 D	25-07-1996
		DK 559069 T	15-07-1996
		EP 0559069 A	08-09-1993
		ES 2089608 T	01-10-1996
		HK 1003986 A	13-11-1998
		JP 6064375 A	08-03-1994
US 5720500 A	24-02-1998	JP 6278390 A	04-10-1994
		AU 667420 B	21-03-1996
		DE 69417604 D	12-05-1999

PATENT COOPERATION TREATY

PCT

REC'D 26 JUN 2000
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
S1297-PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/02771	21/04/1999	30/04/1998
International Patent Classification (IPC) or national classification and IPC G06K19/08		
Applicant INNOVATIVE SPUTTERING TECHNOLOGY N.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
15/11/1999	21.06.00
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Grob, M Telephone No. +49 89 2399 2620

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/02771

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-14	as originally filed			

Claims, No.:

1-32	as received on	29/05/2000	with letter of	25/05/2000

Drawings, sheets:

1/1	as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-32
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-32
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-32
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

element comprising a hologram (cf layers 6-8) and a magnetic layer 4. Since the magnetic layer 4 comprises iron oxide (cf col 5, lines 4-5) for storing information, the magnetic layer 4 would not normally have a "low" coercive force typical of soft-magnetic material (cf page 3, lines 16-18 of the application). Moreover, the magnetic layer 4 does not have at least partially the shape of the embossed pattern of the embossed layer 6 having the form of a diffraction grating (hologram 6-8).

3.1 It is further noted that the hologram in D2 comprises a metal layer 8 comprising chromium, copper, silver or gold or an alloy thereof (cf last line of col 6 - col 7, line 3). The latter metals or alloys are paramagnetic and have a low coercivity. Although claim 1 of D2 refers to the metal layer 8 as a "reflective non-magnetizable metal layer", this merely confirms that the metal layer 8 is not capable of holding a magnetic field once the external field is removed since it is not ferromagnetic but paramagnetic. Hence, it is not clear whether or not these metals or alloys fall within the meaning of "soft-magnetic" materials. However, even if the paramagnetic metal layer 8 were considered as falling within the meaning of "soft-magnetic" material, the paramagnetic effect of the metal layer 8 would be completely swamped by the ferromagnetic iron oxide magnetic layer 4. Hence, the way in which the embossed layer 6 might affect the metal layer 8 would not be detectable externally of the security element. Hence, at least the last feature of claim 1 is not disclosed or suggested by D2.

4. D3 discloses a security element (cf Fig 4 and the passages mentioned in the search report) comprising a base substrate 22, a release layer 23, a hologram forming layer 24 (which has a relief structure), a transparent film 25, a second magnetic layer 26, a first magnetic layer 27 and an adhesive layer 28. According to the text at col 5, lines 4-16, the second magnetic layer 26 has a "low coercive force". Exactly how "low" the coercive force is, is illustrated in col 9, lines 29-31. The value of 300Oe is clearly not that of a "soft-magnetic" material (cf page 3, lines 16-21 of the present application). Moreover, since the second magnetic layer 26 stores data it must be a hard or semi-hard magnetic material in order to reliably store the data after the external field has been removed. Hence, D3 does not disclose or suggest a soft-magnetic material.

5. Consequently, the subject-matter of claim 1 is not suggested by any of the documents D1-D3 or any obvious combinations thereof. Hence, claim 1 (and the dependent claims 2-18,27-29) meets the requirements of Articles 33(2) - 33(4) PCT. Moreover, since the method of claim 19 inevitably results in the production of the security element according to claim 1, claim 19 (and the dependent claims 20-26) also meets the requirements of Articles 33(2) - 33(4) PCT. Also for similar reasons to those in the previous sentence, claim 30 (and the dependent claim 31) also meets the requirements of Articles 33(2) - 33(4) PCT. Furthermore, since none of the available documents discloses or suggests an embossed diffraction grating layer which affects the magnetic properties of a soft-magnetic layer so that the effects are detectable externally of the security element, the step of detecting in claim 32 is not obvious. Hence, claim 32 meets the requirements of Articles 33(2) - 33(4) PCT.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1,D3 is not mentioned in the description, nor are these documents identified therein.

1.1 The description (cf pages 3,8,10) has not been brought into conformity with the new claims as required by Rule 5.1(a)(iii) PCT.

1.2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G08B 13/24, H01F 10/12

A2

(11) International Publication Number: **WO 00/05693**

(43) International Publication Date: 3 February 2000 (03.02.00)

(21) International Application Number: PCT/EP99/04942

(22) International Filing Date: 12 July 1999 (12.07.99)

(30) Priority Data:
98202418.4 20 July 1998 (20.07.98) EP

(71) Applicant *(for all designated States except US)*: INNOVATIVE SPUTTERING TECHNOLOGY [BE/BE]; Karreweg 18, B–9870 Zulte (BE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: TE LINTELO, Johannes [BE/BE]; Clarissestraat 26, B–9000 Gent (BE).

(74) Agent: MESSELY, Marc; 4011 – D.I.E., Bekaertstraat 2, B–8550 Zwevegem (BE).

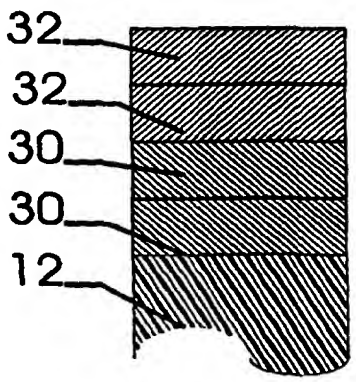
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: SECURITY DEVICE COMPRISING SOFT MAGNETIC THIN FILM

(57) Abstract

A security device such as an anti–pilferage label or authentication label comprises as security feature a (first) soft–magnetic thin film having a thickness ranging from 100 nm to 2000 nm. The thin film is composed of an amorphous $Co_xZr_yNb_z$ alloy, where x, y and z are atomic percentages and fulfil following conditions: (a) x ranging between 80 and 95; (b) y and z ranging between 0 and 20; (c) $y + z = 100 - x$. Due to the high effective relative permeability μ_r, and the direction of its easy axis, a label with a CoZrNb thin film is relatively independent of its geometry.



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SECURITY DEVICE COMPRISING SOFT MAGNETIC THIN FILM

Field of the invention.

The present invention relates to a security device comprising as security feature a (first) soft-magnetic thin film with a thickness ranging from 100 nm (nanometer) to 2000 nm.

The terms "security device" are herein defined as comprising anti-pilferage labels, authentication labels and data carrying labels.

The term "soft-magnetic" generally refers to material having a rather low coercive force H_c ranging from 3 A/m (0.037 Oersted) to 500 A/m (6.28 Oersted). In distinction herewith, hard or semi-hard magnetic material has a much higher coercive force H_c, for example the coercive force H_c of semi-hard magnetic material ranges from 2000 A/m (about 25 Oe) to 8000 A/m (about 100 Oe), and the coercive force H_c of hard magnetic material is higher than 25000 A/m (about 312 Oe). The magnetization of a soft-magnetic material is easily affected by a small external magnetic field, whereas for a hard-magnetic material a strong external magnetic field is necessary to change its magnetization.

Background of the invention.

Security devices with a soft-magnetic thin film as security feature are known in the art.

US-A-4,960,651 discloses an anti-pilferage label comprising a soft-magnetic thin film with a preferable composition along following lines : $Co_aFe_bNi_cMo_dSi_eB_f$, where a to f are atomic percentages and a ranges between 35 % and 70 %, b between 0 % and 8 %, c between 0 % and 40 %, d between 0 % and 4 %, e between 0 % and 30 %, f between 0 % and 30 %, with at least one element of each of the groups (b, c, d) and (e, f) being non zero. Such a $Co_aFe_bNi_cMo_dSi_eB_f$ composition is hereinafter referred to as a CoFeNiMoSiB composition.

Although very suitable as a security device, this type of label has some drawbacks.

First of all, the soft-magnetic thin film must have a thickness greater than 500 nm. Below 500 nm, surface pinning effects become dominant and the signal obtained from the security device in an interrogating gate is rather poor.

Another drawback is that the soft-magnetic thin film has its easy axis in a direction perpendicular to the direction of winding the magnetic thin film. This makes it difficult to make and/or use labels with a high aspect ratio, e.g. with dimensions 40 mm x 1 mm, where the long axis is in the roll-direction. For example, use of such labels at high speed in source-tagging or using application guns is causing more failures and production stand stills.

Summary of the invention.

It is an object of the present invention to avoid the drawbacks of the prior art.

It is another object of the present invention to provide for a security device where the security feature is less bound to geometrical limitations than is the case with prior art security devices.

It is still another object of the present invention to provide for a security device with a soft-magnetic thin film of a reduced thickness.

According to the present invention, there is provided a security device which comprises as security feature a soft-magnetic thin film having a thickness ranging from 100 nm to 2000 nm. The thin film is composed of an amorphous $Co_xZr_yNb_z$ alloy, where x, y and z are atomic percentages and fulfil following conditions :

(a) x ranging between 80 and 95 in order to obtain a saturation flux density B_s above 9000 Gauss, e.g. above 10000 Gauss ;

(b) y and z ranging between 0 and 20 ;

(c) $y + z = 100 - x$.

These $Co_xZr_yNb_z$ alloys are referred to as CZN compositions.

Following CZN compositions are given as examples :

$Co_{87}Zr_5Nb_8$

$Co_{89}Zr_{4.5}Nb_{6.5}$

$Co_{89}Zr_{11}$

$Co_{93}Zr_7$

$Co_{90.6}Zr_{1.4}Nb_8$

CZN compositions are known as such for use in magnetic recording applications (e.g. as materials used in recording heads) and for use in antennas. However, the effective relative permeabilities μ_e reported in these applications are significantly lower in magnitude than those found in the present invention.

Thin films made of CZN compositions have an effective relative magnetic permeability μ_e ranging between 20000 and 200000, of course very dependent on sample dimensions.
The effective relative magnetic permeability μ_e is determined as the slope of a hysteresis curve as measured by means of a magneto meter at the coercive point, i.e. the point where the magnetic induction flux B is zero.
The above values of μ_e are higher than the effective relative magnetic permeability μ_e of comparable CoFeNiMoSiB thin films, i.e. with an equal thickness. The CoFeNiMoSiB thin films have an effective relative magnetic permeability μ_e ranging between 20000 and 60000.
This means that, in comparison with such CoFeNiMoSiB compositions, either less material can be used, for example by reducing the thickness of the thin film or by using other label geometries which have not been possible up to now, or that the signals measured in anti-pilferage detection systems or in authentication detection systems have a larger amplitude resulting in the possibility of going to larger detection distances e.g. wider exit gates in electronic article surveillance applications.

It has proved to be possible to reduce the thickness of a CZN thin film to below 500 nm, without experiencing the above-mentioned surface pinning effects and without experiencing responsive signals which are

too low. This is important not only with respect to a potential saving of material but also with respect to its influence on the effective relative permeability μ_e of a magnetic security feature. Indeed the effective relative permeability μ_e of a magnetic security tag, i.e. the magnetic permeability as seen from outside the tag, may be derived approximately from the formula :

$$1 / \mu_e = 1 / \mu_r + N$$

where μ_r is the intrinsic relative magnetic permeability and where N is the demagnetisation factor. The demagnetisation factor N or its inverse, 1 / N, the shape factor, can be calculated as function of the geometrical shape of the security tag.

Take, for example, a security tag having a fixed length L of 30 mm and a fixed width W of 30 mm. The demagnetisation factor N and the shape factor 1 / N change as follows with decreasing thickness T of the security tag :

Thickness T (nm)	Demagnetisation factor N	Shape factor 1 / N
800	4.48×10^{-4}	2232
550	3.08×10^{-4}	3572
400	2.24×10^{-4}	4464

Decreasing the thickness T of the security tag increases the shape factor and, as a consequence, also the effective relative magnetic permeability μ_e.

The increased shape factor also results in an improved non-linear behaviour of the hysteresis curve to small interrogating magnetic fields so that the security device is not only better detected in security detecting devices, but this is also the case in anti-pilferage systems based on harmonics as in "Barkhausen" anti-pilferage systems (as commercialized by Sensormatic and Certus).

The fact that with CZN thin films one is able to reduce the thin film thickness to below 500 nm also means that there will be - in comparison with CoFeNiMoSiB thin films a reduced amount of eddy-currents and a reduced hysteresis loss with high frequencies.

Still another advantage of the thin CZN thin films is that they also allow to reduce the thickness of the substrate, due to lower heat-load of the deposition process on the substrate. This results in the advantage of lower cost, possibility of longer production runs and a more environment-friendly process.

So it represents a significant advantage that in case of CZN thin films the thickness can be reduced to lower than 500 nm.

The CZN thin films further have following magnetic properties :

- a coercive field H_c ranging between 5 A/m and 80 A/m ;
- an anisotropy field H_k ranging between 500 A/m and 5000 A/m.

CZN thin films have proved to give an easy axis in the direction of the winding of the thin film during manufacturing by means of a webcoater. This makes a CZN thin film suitable for elongated labels with e.g. a length to width ratio being higher than 2, for example ranging from 10 to 100.
This makes a CZN thin film also suitable for combination with other thin films such as CoFeNiMoSiB thin films which have their easy axis in a direction perpendicular to the direction of the winding of the thin film. By combining a CZN thin film with a CoFeNiMoSiB thin film a 360° detection label can be obtained.

Brief description of the drawings.

The invention will now be described into more detail with reference to the accompanying drawings wherein

- FIGURE 1 schematically illustrates how a CZN soft-magnetic thin film is applied to a substrate ;
- FIGURE 2A, FIGURE 2B, FIGURE 2C, FIGURE 2D, FIGURE 2E and FIGURE 2F illustrate various embodiments of a 360° label by combining a CZN thin film with a CoFeNiMoSiB thin film.

Description of the preferred embodiments of the invention.

Referring to FIGURE 1, reference number 10 represents a cross-section of a high vacuum chamber, i.e. a chamber at 10^{-1} to 10^{-5} Pa. Vacuum pumps (not shown) are connected to chamber 10 by means of conduit pipes 11. A flexible substrate 12 such as a polymer film is unwound from a storage drum 14 and guided to a coating or cooling drum 16. When passing along magnetrons 18, 20, 22 and 24, ultra-thin layers of the CZN target material are sputtered onto the surface of the substrate 12. The coated substrate 26 is then rewound on the other side of the coating drum 16 on another storage drum 28. The sputtering starts when a negative voltage is applied to the CZN target material and when an inert gas flow is introduced into the vacuum chamber 10 up to a total pressure of between 8.10^{-4} mbar and 5.10^{-2} mbar. Positive argon ions, which originate due to the electric and magnetic fields, are accelerated towards the negatively biased target, impinge on it with high energy and release atoms from the target. These atoms have enough energy to travel to the substrate where they are stopped and bonded, forming a high precision coating.

The CZN soft-magnetic coating according to the invention can be made by means of a single, double or multiple pass vacuum magnetron-sputtering operation.

The anisotropic behaviour of the magnetic properties can be tailored by proper arrangement of magnetic flux lines. Furthermore, the deposition power, cooling of drum and type of substrate are important factors that influence the anisotropic behaviour and magnetic properties in general. This anisotropic behaviour makes the soft-magnetic coating according to the invention different from soft-magnetic coatings of similar CZN composition, as used in magnetic recording heads.

The deposition process according to the invention results in softer magnetic properties in the direction of the easy axis, than soft-magnetic coatings of similar composition, as used in magnetic recording heads. This is achieved by the nature of the webcoating process.

Referring both to FIGURE 1 and to FIGUREs 2 (A through F), a 360° label can be obtained by combinations of CZN thin films with easy axis in the direction of winding and CoFeNiMoSiB thin films with easy axis perpendicular to the direction of winding. These combinations can be obtained by lamination or in-situ deposition of the two different materials. For example the following combinations can be deposited in-situ, in the vacuum-coating chamber as given in FIGURE 1.

FIGURE 2A : A double layer comprising a CZN layer 30 and a CoFeNiMoSiB layer 32 can be obtained with CZN targets on magnetron positions 18 and 20, and CoFeNiMoSiB targets on magnetron positions 22 and 24.

FIGURE 2B : A multi-layer comprising alternating CZN layers 30 and CoFeNiMoSiB layers 32 can be obtained with CZN targets on magnetron positions 18 and 22, and CoFeNiMoSiB targets on magnetron positions 20 and 24.

FIGURE 2C : A double layer comprising a CZN layer 30 and a CoFeNiMoSiB layer 32 can be obtained with a CZN target on magnetron position 18, and CoFeNiMoSiB targets on magnetron positions 20, 22 and 24.

FIGURE 2D : A double layer comprising a CZN layer 30 and a CoFeNiMoSiB layer 32 can be obtained with CZN targets on magnetron positions 18, 20 and 22 and a CoFeNiMoSiB target on magnetron position 24.

FIGURE 2E : A double layer comprising a CZN layer 30 and a CoFeNiMoSiB layer 32 can be obtained with a CoFeNiMoSiB target on magnetron position 18, and CZN targets on magnetron positions 20, 22 and 24.

FIGURE 2F : A double layer comprising a CZN layer 30 and a CoFeNiMoSiB layer 32 can be obtained with CoFeNiMoSiB targets on magnetron positions 18, 20 and 22, and a CZN target on magnetron position 24.

Of course, other combinations are possible depending on the number of magnetrons available in the webcoater and on the required magnetic properties.

As a matter of example, following values of magnetic properties have been measured on 30 mm x 30 mm soft-magnetic thin films :

	H_c (16 Hz) (mOe)	H_c (1 kHz) (mOe)	μ_e (16 Hz)	μ_e (1 kHz)
CoFeNiMoSiB thin film thickness = 850 nm	80	410	50000	32000
CZN thin film thickness = 550 nm	110	320	100000	70000

CLAIMS

1. A security device comprising as security feature a first soft-magnetic thin film (30) having a thickness ranging from 100 nm to 2000 nm, characterized in that
said thin film is composed of an amorphous $Co_xZr_yNb_z$ alloy, where x, y and z are atomic percentages and fulfil following conditions :
(a) x ranging between 80 and 95 ;
(b) y and z ranging between 0 and 20 ;
(c) $y + z = 100 - x$.

2. A security device according to claim 1
wherein said first thin film has an effective relative magnetic permeability μ_e measured at DC ranging between 20000 and 200000.

3. A security device according to any one of the preceding claims
wherein said first thin film has a coercive field H_c ranging between 8 A/m and 80 A/m.

4. A security device according to any one of the preceding claims
wherein said first thin film has an anisotropy field H_k ranging between 500 A/m and 5000 A/m.

5. A security device according to any one of the preceding claims
wherein said first thin film has a thickness smaller than 500 nm.

6. A security device according to any one of the preceding claims
wherein said first thin film has its easy axis in the direction of winding of the film.

7. A security device according to claim 6 wherein said device further comprises at least one other thin film having an easy axis perpendicular to the direction of the easy axis of the first thin film.

8. A security device according to any one of the preceding claims wherein said device is an anti-pilferage label.

9. A security device according to any one of claims 1 to 7 wherein said device is an authentication label.

10. A security device according to any one of claims 1 to 7 wherein said device is a data carrying label.

11. A security device according to any one of claim 8 to 10 wherein said label has a length to width ratio greater than 2.

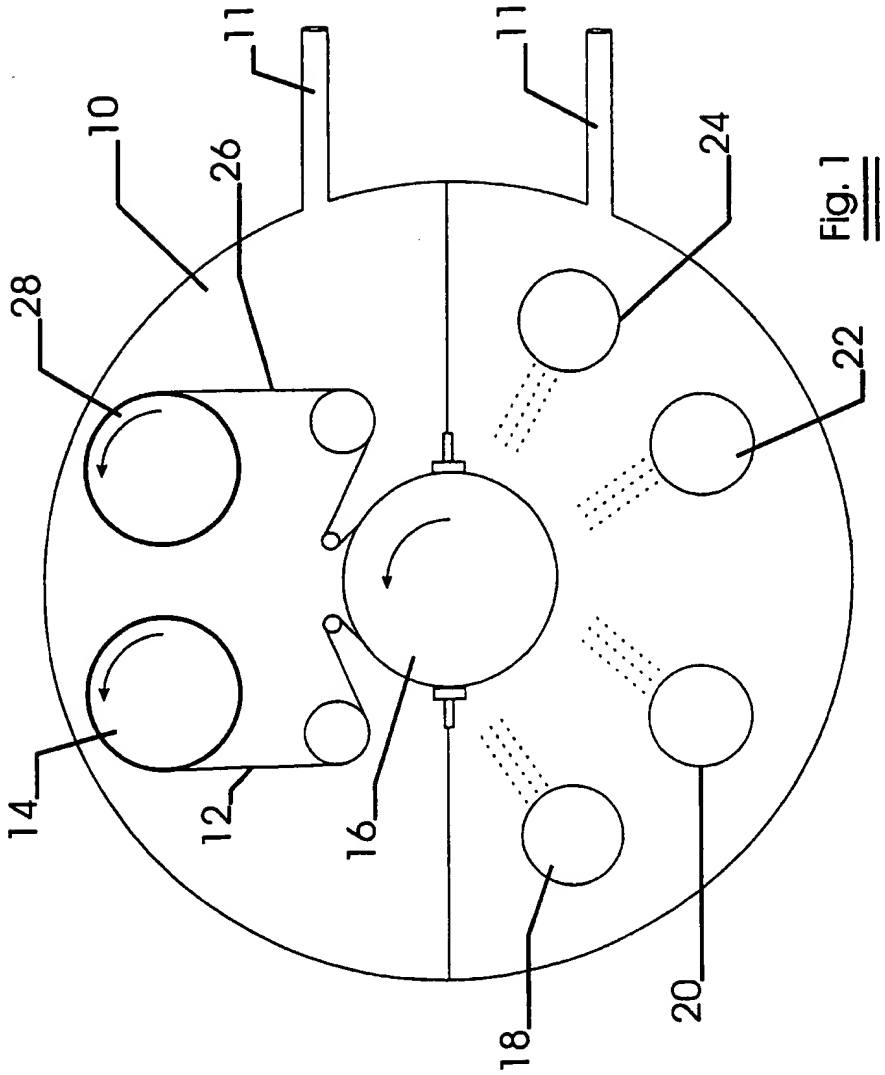

Fig. 1

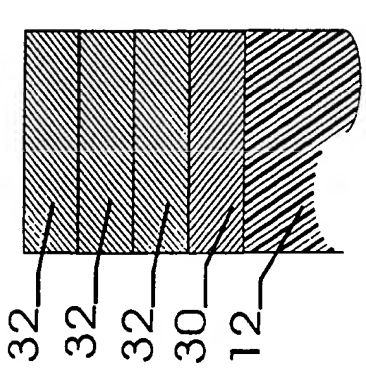

Fig. 2C

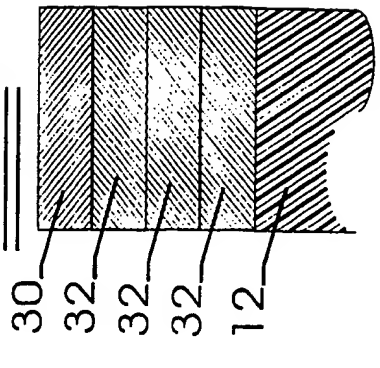

Fig. 2F

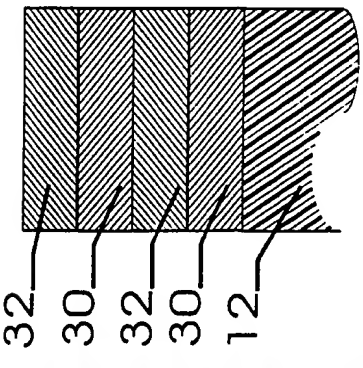

Fig. 2B

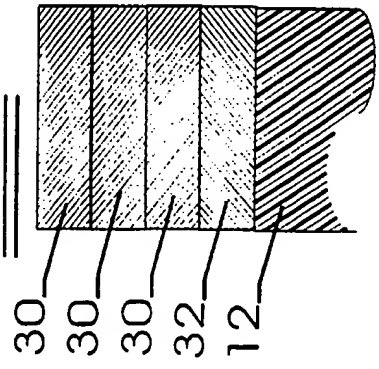

Fig. 2E

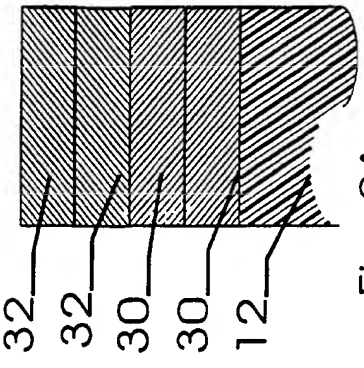

Fig. 2A

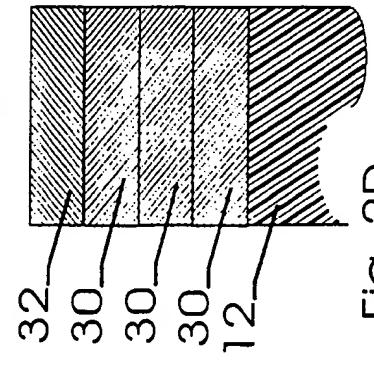

Fig. 2D

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G06K 19/08 — A1

(11) International Publication Number: **WO 99/57682**

(43) International Publication Date: 11 November 1999 (11.11.99)

(21) International Application Number: PCT/EP99/02771

(22) International Filing Date: 21 April 1999 (21.04.99)

(30) Priority Data:
98870098.5 30 April 1998 (30.04.98) EP

(71) Applicants *(for all designated States except US)*: INNOVATIVE SPUTTERING TECHNOLOGY N.V. [BE/BE]; Karreweg 18, B–9870 Zulte (BE). SECURENCY PTY. LTD. [AU/AU]; Hume Highway, Craigieburn, VIC 3064 (AU).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LIPPENS, Paul [BE/BE]; Ichtegemstraat 23, B–8610 Kortemark (BE). POWER, Gary [GB/GB]; 6 Pine Terrace, Silloth, Cumbria CA5 4DT (GB).

(74) Agents: BIRD, William et al.; Bird Goën & Co., Termerestraat 1, B–3020 Winksele (BE).

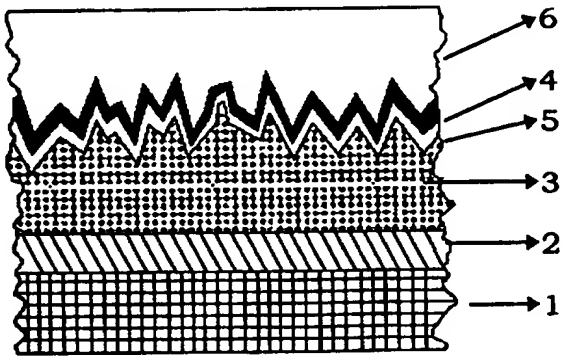
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SECURITY ELEMENT TO PREVENT COUNTERFEITING OF VALUE DOCUMENTS

(57) Abstract

The invention relates to a security element comprising a magnetic layer and an embossed layer characterised in that the magnetic layer is a soft–magnetic layer and in that the soft magnetic layer has, at least partially, the shape of the embossed pattern of the embossed layer, whereby the embossed layer affects the magnetic properties of the soft–magnetic layer, to a process of manufacture thereof and to the use of such a security element to avoid counterfeiting of value documents.



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SECURITY ELEMENT TO PREVENT COUNTERFEITING OF VALUE DOCUMENTS

FIELD OF THE INVENTION

The present invention relates to a security element particularly useful to protect value documents such as bank notes, credit cards, bank cards, cheques or others products of some value, such as software, CD, video-cassettes, perfumes, clothing, and the like. In another of its aspects, the invention relates thus to the protected value document. Finally the invention relates also to a method of manufacturing such a security element.

DESCRIPTION OF THE BACKGROUND ART AND OBJECT OF THE INVENTION

In recent years, counterfeiting or falsification of value documents including bank notes, debit or credit cards has proliferated. Security systems for incorporation into such value documents involve the incorporation of encoded data, either visibly or invisibly or both, into or on the document substrate and a system for reading out the encoded data to authorise use of the document.

One form of value document can be found in U.S. Patent No. 4,684,795. This value document carries, on at least one of its surfaces, a security feature or element which includes a magnetic layer comprising a dispersion of magnetisable particles in a binder and a security layer which has an optical-diffraction effect, for example a hologram or a computer-generated diffraction layer, an interference layer or a diffraction grating. In that document, the security layer is superimposed on the magnetic layer at least in a region-wise manner thereon, while the surface of the security layer which is towards the magnetic layer has a spatial structure with an optical-diffraction effect. The security layer is further provided with a reflective non-magnetisable metal layer.

However, it has been found that, in some circumstances, the reflective non-magnetisable metal layer can be damaged or changed at least in regard to its appearance. That can adversely affect the proper functioning of the security feature. That becomes apparent in particular when the structure of the security layer, which has an optical-diffraction effect, is a machine-readable structure, for example, a

hologram or a computer-generated diffraction structure.

U.S. Patent No. 5,383,687 describes a value document comprising a magnetic layer in combination with a security layer which does not exhibit such drawback. To prevent damage to the reflective metal layer, said metal layer is formed by a metal which does not react with the magnetisable particles of the magnetic layer. In a variant, a barrier layer is disposed between the metal layer and the magnetic layer. The suitable metal layer can be selected from copper, chromium, silver or gold or at least an alloy thereof. The magnetic particles in the magnetisable layer can be chosen from the group consisting of g-Fe_2O_3 pigments, Co-doped iron oxides or other magnetic materials such as Sr, Ba-ferrite.

Value documents protected as described above, still exhibit several drawbacks. First, they possess an important number of different layers and are thus relatively difficult and expensive to manufacture.

Next, their magnetic layer is always made of hard or semi-hard magnetic material so that the protected documents might interfere with magnetic storage devices such as video-tapes for example.

European Patent Application EP-A-0673 583 describes an anti-theft article comprising a visual authentication mean and an electromagnetic element. The electromagnetic element, e.g. a soft-magnetic layer, and the authentication mean, e.g. a hologram, are bound with an adhesive layer.

The security layer with an optical diffraction effect is always connected (e.g. by means of an adhesive) to the magnetic layer. It is thus possible to separate one of these elements from the other and to analyse and reproduce it. The hologram could be easily reproduced by contact or mechanical copying or any other method usually used by counterfeiters.

It is therefore an object of the present invention to provide a security element which does not exhibit such drawbacks.

An object of the invention is to provide a security element in which the anti-counterfeiting properties of a diffraction grating device, like an optically variable device (OVD), more particularly like a hologram are intimately associated with the anti-counterfeiting properties of a soft-magnetic material.

Another object of this invention is to provide a security element in which the

diffraction grating device contains also information which could be read by a machine.

Another object of the invention is to provide a security element which is easy to manufacture.

Such a security element would show several advantages : it is very difficult to copy because the absence of one of its components, i.e. the soft-magnetic material element, is readily detected but parts of the information it contains remain unknown from the public. In general, removal of the diffraction grating device means at the same time removal of the magnetic element.

DESCRIPTION OF THE INVENTION

In accordance with the invention, a soft-magnetic material is used to produce an optical-diffraction effect when directly applied on an embossed surface. The diffraction grating device and the soft-magnetic layer are thus combined into one object.

The term soft-magnetic refers to material having a rather low coercive force, for example a coercive force ranging from 3 A/m (0.037 Oersted) to 500 A/m (6.28 Oersted). Hard or semi-hard magnetic material has a much higher coercive force, for example the coercive force for the semi-hard magnetic material ranges from 2000 A/m (about 25 oersted) to 8000 A/m (about 100 Oersted), and the coercive force for hard magnetic material is higher than 25000 A/m (about 312 Oersted).

A soft-magnetic material only shows magnetic properties when exposed to a magnetic field while hard-magnetic materials show permanent magnetic properties. Surprisingly it has been found that the pattern of the diffraction grating device modifies the signal that can be read from the soft magnetic layer. Such property allows to create specific magnetic response from specific pattern, like a magnetic finger print.

Accordingly, the invention relates to a security element comprising a magnetic layer and an embossed layer characterised in that the magnetic layer is a soft-magnetic layer and in that the soft magnetic layer has, at least partially, the shape of the embossed pattern of the embossed layer, whereby the embossed layer affects the magnetic properties of the soft-magnetic layer. The affect on the magnetic properties of the soft magnetic layer is at least a change of 10% in the relative permeability or at

least a change of 10% in the coercive force.

It is essential to understand that for the embossed layer to affect the magnetic properties of the soft-magnetic layer, the soft-magnetic layer must, at least partially, take the shape of the embossed pattern of the embossed layer. Therefore, the soft magnetic layer may lie directly on the embossed layer or on another layer having the shape of the embossed layer. The soft magnetic layer need not be work hardened in order to affect its magnetic properties, for instance, it may be sputtered onto the embossed layer.

The decomposition of such a security element is almost impossible, because of the association of the magnetic alloy layer with the embossed surface. Trying to remove the magnetic alloy layer will damage the embossed pattern, making the reproduction of the diffraction grating device inaccurate and inoperative. On the opposite, counterfeiting a security element using only the diffraction grating device will be inoperative because the absence of the soft-magnetic material could be easily detected.

Optional layers which may be present in the security element which is the object of the present invention are one or more other metallic layers, chosen with a high reflectivity, to enhance the optical aspect of the diffraction grating device. Aluminium is particularly suitable therefor. This optional metallic layer may be applied by any method well-known in the art, such as vacuum metallisation.

It has been observed that the soft-magnetic layer has a relatively weak glossiness. It is therefore of interest to add a metal layer with high specular reflectance. It will be understood that such a glossy layer must be deposited on at least one visible side of the security element.

Therefore, if the substrate to which the security element is to be affixed is opaque, the said metal layer is to be deposited on the embossed layer before the soft-magnetic layer. If, on the contrary, the substrate (or at least the region of the substrate where the security element is to be affixed) is transparent, the metal layer may be deposited on the top of the soft-magnetic layer. In the last case, however, the metal layer could also be deposited before the soft-magnetic layer or on both sides of the soft-magnetic layer.

In a preferred embodiment, the invention relates therefore to such a security element, characterised in that the security element further comprises a metal layer

with a high specular reflectance.

Particularly, the invention relates to such a security element in which the metal layer with a high specular reflectance is chosen between aluminium, silver, chromium, gold or any other highly reflective metal layer or metal oxide such as titanium dioxide, niobium dioxide, tin oxide, indium oxide, indium - tin oxide or zinc oxide, preferably aluminium.

Another optional layer consists of an adhesive layer, such as a pressure-sensitive adhesive layer, a contact adhesive layer, a hot melt adhesive layer, a hot stamp adhesive layer or any other kind of adhesive layer. This adhesive layer can be a commercial product like Durasol 326 or its equivalent (Albright and Wilson). This is a methyl methacrylate / butyl acrylate copolymer, in solution in methylethylketone/toluene. The additives present in the adhesive layer include a hot stamping break promoter, like Silica Wacker HDK H15 or Aerosil R971 and an adhesion promoter like the vinyl resin VMCH from Union Carbide.
The adhesive layer can be applied by gravure process or any other coating process known in the art.

The invention also relates to such a security element, characterised in that the security element further comprises an adhesive layer such as a pressure-sensitive adhesive layer, a contact adhesive layer, a hot melt adhesive layer, a hot stamp adhesive layer or any other kind of adhesive layer.

Particularly, the invention relates to such a security element in which the adhesive layer comprises an a,b-ethylenically unsaturated carboxylic acid-based resin to allow the security element to be permanently affixed to the substrate. Obviously other means of fixation of the security element to the substrate are encompassed within the scope of the present invention.

The embossable layer can be made of any embossable coating composition well-known in the art. This coating composition consists usually of thermoplastic polymer of relatively high molecular weight, in the form of a solution in an organic solvent, and of conventional additives such as ultraviolet absorbing compounds, light stabilizers, antioxidants as well as various opacifying pigments such as metal oxides. Once applied on the carrier film surface, the coating undergoes hardening through crosslinking. In a variant, the thermoplastic polymer with a relatively high molecular weight may form a water-borne emulsion. Once applied on the carrier film surface,

the coating undergoes hardening through evaporation of water.

Examples of embossable coating compositions contain as binder a mixture of carboxyl group-containing polymers, such as a carboxyl group-containing polyester or polyacrylate, and epoxy compounds, such as triglycidyl group-containing acrylic copolymers or b-hydroxyalkylamides or a mixture of hydroxyl group-containing polymers, most often hydroxyl group-containing polyesters, with blocked or non-blocked isocyanates, melamine resins, and the like.

In a particular embodiment, the invention relates to a security element in which the embossed layer comprises an a,b-ethylenically unsaturated carboxylic acid-based resin. An example of embossable coating composition suitable for the present invention is illustrated as follows: the coating composition can be prepared with commercial products like Paraloid A11 (from Rohm and Haas). This product is an acrylic lacquer dissolved in methylethylketone and toluene. The viscosity of the applied composition can be adjusted if required with isopropanol.

The diffraction grating device used in the present invention can be an holographic image, a computer-generated diffraction structure or any other spatial structure with an optical diffraction effect.

Such diffraction grating device can be obtained by embossing the embossable layer with a hot stamp press like the Milford Astor M50 (single impression machine), with a continuous embossing machine like the CSIRO-RBA-EI, with a high-speed embossing machine like the Rotomec Laminator or with any other machine well-known from the art.

In a preferred mode, the invention relates to a security element in which the diffraction grating pattern is obtained by embossing to form a hologram.

The soft-magnetic material consists essentially of a soft-magnetic thin film with an optical reflection high enough (specular reflectivity is typically higher than 45%, by preference 58%) in order to create a diffraction grating device on an embossed surface.

The soft-magnetic material used according to the present invention can be selected from the soft magnetic materials known in the art.

Particularly, soft-magnetic alloys such as the ones mentioned in patent EP 0 295 028 B1, can be used A Co alloy which works excellent is the one used in ATALANTE® soft-magnetic films. ATALANTE® is a trademark of Innovative

Sputtering Technology (I.S.T.) N.V., Belgium.

The magnetic material deposited may be a mixture of metallic elements with a suitable glass-forming element or elements. Compositions typical of those currently used to form melt-spun magnetic metallic glasses are suitable. One such composition is Co-Nb with a suitable glass forming element such as Zr. Other suitable amorphous alloys include the transition metal metalloid (T-M) and transition metal transition metal

(T-T) alloys. Typical metalloids in this context are boron, carbon, silicon, phosphorus and germanium, which may form about 15 - 30% of the alloy. T-T alloys contain late transition metals such as Fe, Co, Ni or early transition metals such as Zr and Hf and have good thermal stability. The composition of T-M type alloys amenable to solidification to an amorphous phase is typically around $T_{80}M_{20}$ e.g. $Fe_{80}B_{20}$;

By adding Co and Ni to Fe-B systems, an increase in Curie temperature results, with an increase in saturation magnetic induction. The addition of other metalloids also has an effect on material properties such as saturation magnetic induction, Curie temperature anisotropy, magnetisation and coercivity. The most appropriate alloy for any particular application can be selected through consideration of the desired properties.

The preferred alloys are combinations of elements, generally of metal and metalloid elements, which when combined in the correct atomic percentages, give an amorphous structure under the right deposition conditions. Many such alloys contain Co, Fe, Si and B. Ni may also be present. Suitable alloys are amorphous metal glasses, for example: $Co_a Fe_b Ni_c Mo_d Si_e B_f$ where a is in the range of 35 to 70 atomic percent, b zero to 8 atomic percent, c zero to 40 atomic percent, d zero to four atomic percent, e zero to thirty atomic percent and f zero to thirty atomic percent, with at least one of groups b, c, d and e, f being non zero. The inclusion of nickel is found to assist in increasing the ducitility of the product, which facilitates its handling and usage. Suitable properties may also be achieved with alloys of iron, aluminium and silicon that are designed to have zero magnetostriction. Magnetic properties of some alloys are very sensitive to a change in their stoechiometric composition. Others are magnetostrictive and hence do not possess a sufficiently high permeability. The ratio Co/Fe markedly affects the magnetostrictive properties of the alloy; the atomic ratio

Co/Fe is preferably in the range 8:1 to 20:1.

One satisfactory alloy is $Co_{66} Fe_4 Mo_2 Si_{16} B_{12}$. Another may contain manganese in place of molybdenum. A further alloy has the composition Co, 42; Fe, 4; Ni, 28; Si, 16; B, 9 atomic percent.

The invention relates also to a security element in which the soft magnetic layer consists essentially of an alloy containing cobalt and niobium, together with a glass-forming element.

The invention relates also to a security element in which the soft magnetic layer consists essentially of an alloy containing cobalt, iron, silicon and boron, optionally further containing nickel.

In a variant, the invention relates to a security element in which the soft magnetic layer is made of an alloy which has the formula :$Co_a Fe_b Ni_c Mo_d Si_e B_f$, where a is in the range of 35 to 70 atomic percent, b zero to 8 atomic percent, c zero to 40 atomic percent, d zero to 4 atomic percent, e zero to 30 atomic percent and f zero to 30 atomic percent, with at least one of the group b,c,d and e,f being non zero. Particularly, the invention relates also to a security element in which the soft magnetic layer is made of an alloy with a composition (in atomic percent) in the range :Co 35-70, Fe 2-7, Ni 10-35, Mo 0-2, Si 12-20 and B 6-12.

The invention relates also to a method for producing such a security element, comprising the steps of :

a) applying a release coating on a polymeric film carrier

b) applying an embossable layer on the polymeric film which is used as carrier,

c) embossing the embossable layer with an diffraction grating pattern such as a hologram, and

d) applying a soft-magnetic layer on the embossed face of the embossed layer.

The application of the soft-magnetic layer on the embossed surface of the embossed layer affects its magnetic properties. Optionally the method further comprises the step of applying an adhesive layer such as a pressure-sensitive adhesive layer, a contact adhesive layer, a hot melt adhesive layer, a hot stamp adhesive layer or any other kind of adhesive layer, on top of the soft-magnetic layer.

Particularly, the invention relates also to a method for producing such a security element, further comprising the step of optionally applying a metal layer with

a high specular reflectance. The optional metal layer with a high specular reflectance can be applied on the soft-magnetic layer or under it.

The release coating can be applied on a carrier film (step a)), suitable for further hot stamp process. Such carrier film can be a polyester film, such as polyethylene terephtalate film (Melinex S from ICI Australia, Mylar-A from DuPont) or other carrier films such as Cellophane®.

This release coating composition can be chosen from polymers, waxes, gums, gels and mixtures thereof. This release coating composition can be applied, for example, by a gravure process or any application technique well-known in the art. The embossable layer can be applied on top of the release coating (step b)) for example, by a gravure process or any application technique well-known in the art. The deposition technique for the soft-magnetic material can be sputtering e.g. DC magnetron sputtering, electron beam or thermal evaporation (enabling a faster deposition rate but achieving a less dense product) or electrolysis. Another technique is organometallic vapour pyrolysis. Further possibilities include, laser driven physical vapour deposition in which a laser beam is scanned over a target surface to ablate the material to be deposited and deposition from a liquid using a chemical technique. The preferred deposition technique is DC magnetron sputtering.

As mentioned previously, the soft-magnetic amorphous metal glass thin film coating may be deposited by sputtering electron beam evaporation, or electroless or electrolytic chemical deposition. To achieve the desired magnetic properties, in particular low coercivity for a sputtered film the sputtering pressure is preferably between 0.1 and 10 Pascals of argon, depending on the geometry of the coater and on the composition of the sputtered material. The lower the gas pressure, the denser the sputtered product since the mean free path for the sputtered atoms between target and substrate is reduced.

The targets used for sputter depositing the active magnetic layer are preferably prepared by hot isotactic pressing (H.I.P.) starting from a pre-alloyed gas atomised powder.

The deposition technique for the metal layer with a high specular reflectance may be the same as for the soft-magnetic layer. Preferably, this step is performed in-line with the soft-magnetic layer deposition.

The security element object of the present invention can be utilised with

security documents such as banknote and the like, but also with any documents or means of identification for authentication purposes. Such documents or means include credit cards, cheques, bonds or any document where security or authenticity is an issue such as labels.

Therefore, another object of the invention relates to a security document having such a security element. Particularly, such security document is a bank note, a credit card, a cheque or a label.

The method for manufacturing such a security document comprises the transfer of a security element of this invention onto a substrate for example by hot stamp process (transfer coating).

The substrates which can be used according to the present invention include paper, polyolefin films and polymer films in general, rigid polymer materials, metallic foil and the like. Bioriented polypropylene films are preferred.

The substrate can be a continuous web or sheet of suitable material. The substrate can be clear or opaque.

Furthermore, if necessary, a release film or sheet consisting of a release agent, can cover the adhesive layer.

This laminate comprising the security element according to the invention can be used as an adhesive label which may be affixed to most types of surface.

The following examples are given for the purpose of illustrating the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1, Figure 2 and Figure 3 all show layered structures of security elements according to the present invention. For a better understanding of the present invention, reference will be made to the accompanying drawings, in which

Figure 1 shows a security element object of the present invention, comprising a polymeric film carrier (1), a release coating layer (2), an embossed layer (3) and a soft-magnetic layer (4).

Figure 2 shows the same security element as in Figure 1, but further comprising a metal layer with a high specular reflectance (5) and an adhesive layer (6).

Figure 3 shows a security document after the security element as described in Figure 2 has been transferred by a hot stamp process on a substrate (7).

Example 1 : Manufacturing of a security element in the form of a label

Carrier

The carrier for the hot stamp film is Melinex polyester grade S 23 μm thick, from ICI Australia.

Release coating

The release coating is Carnoba wax and is coated on the carrier film with a gravure coater.

Embossable layer solution

The embossing layer is prepared from Paraloid A11 from Rohm and Haas. This is an acrylic lacquer supplied as 100% in a granular form. The melting temperature (hot bar) is between 160°C and 170°C. The lacquer solvent is a mixture methylethylketone and toluene. the viscosity modifier is isopropanol.

1 part of Paraloid A11 is added under stirring to 4 parts of toluene, at a temperature of about 50°C. A 20% solids solution is obtained by adding extra toluene after the complete dissolution of the lacquer. The solution is filtered through a glass wool pad and the viscosity is adjusted if required with isopropanol.

Application of coating

The embossable coating solution is applied by a gravure process with a rotating smoothing bar on the carrier film. The viscosity is adjusted to 22 seconds (measured by No. 2 Zahn cup).

The gravure cylinder engraves mechanically 110 lines per inch and at 50 μm cell depth.

The final weight of coating is around 1.5 ± 0.3 g/m^2.

The solvent is then removed from the coated film with a good air flow at a temperature of at least 55°C.

Embossing of hot stamp film

The Paraloid coating on the Melinex is embossed by hot pressing with a modified Rotomec Laminator (410 mm wide). The impression force is about 800 kPa on gauge. The impression roller hardness is about 85 (shore hardness). The embossing temperature is about 125°C. The pre heat temperature is about 120°C. The chill roll temperature is 10-15°C. The web speed is 30 m/min and the web tension is TBE.

Soft-magnetic layer

The embossed coated film is metallized with ATALANTE® or any other kind of soft-magnetic alloy generating harmonics of a base-frequency.

The soft-magnetic metal layer is deposited by magnetron sputtering. The thickness can be varied in the range from 150-700 nm.

Adhesive layer

The coating adhesive is Durasol 326 (Albright and Wilson). This is a methyl methacrylate/butyl acrylate copolymer. The melting temperature is between 120°C and 135°C. The reducing solvent is a mixture of toluene and methylethylketone. The additives include a hot stamping break promoter Silica HDK H15 (Wacker) and an adhesion promoter, the vinyl resin (Union Carbide).

The adhesive solution contains 7% (on solids) of adhesion promoter vinyl resin VMCH and 1% (on solids) of Silica HDK H15. The adhesion promoter is prepared by dissolving the vinyl resin VMCH in methylethylketone solvent to make up a 20% solids solution. The break promoter is made up by mixing the Silica HDK H15 in toluene to a homogenous paste.

The adhesion promoter mix and the break promoter mix are then added to the Durasol 326 with continuous mixing. After the addition is complete, the Durasol 326 is reduced with toluene/methylethylketone 50:50 to the required viscosity and around an 18% solids solution.

Application of coating

The adhesive coating is applied by gravure process on the top of the soft-magnetic layer.

The viscosity is 22 seconds (No. 2 Zahn cup). The gravure cylinder engraves mechanically at 110 lines/inch and 50 μm cell depth. The final weight of coating is

around 1.8 ± 0.2 g/m^2.

The coating is then dried as completely as possible by heating the web at a temperature of at least 55°C and under an adequate air flow.

Example 2 : characterisation of the security element

Several security elements were manufactured according to the process described in example 1, and their magnetic properties were tested.

No.	quality of OVD	Thickness of the soft-magnetic layer (nm)
1	granular, coarse embossing pattern(A)	170
2		350
3	fine embossing patterns(B and C)	170
4		350
5		285
6		235
7	reference film without embossing	370

The example No. 7 is intended to serve as comparative example only.

In the examples 1 and 2, a coarse embossing pattern A was used while in the examples 3 to 6 two high resolution patterns (B and C) were embossed. The differences of magnetic properties and thus the influence of the embossing patterns on the magnetic signal are clearly illustrated in the following table.

The coercivity and the permeability of the samples were measured at 1 kHz with a magnetometer.

	No embossing pattern		Embossing pattern A		Embossing pattern B		Embossing pattern C	
No.	Hc (Oe)	μ	Hc (Oe)	μ	Hc (Oe)	μ	Hc (Oe)	μ
1			> 1	< 5000				
2			> 1	< 5000				
3					> 1	< 5000	> 1	< 5000

4			0.60	8000	0.65	9000
5			0.72	6000	0.76	7500
6			> 1	< 5000	> 1	< 5000
7	0.54	23000				

μ : magnetic permeability

Hc : coercivity (measured in Oersted)

From these measures, one can see that :

- the intrinsic magnetic properties like coercivity and permeability are affected by the embossing patterns (compare the permeabilities of examples 1 to 6 with example 7) by at least 10%
- the intrinsic magnetic properties like coercivity and permeability are affected by the type of embossing (compare the coercivities of the embossing patterns B and C).

CLAIMS

1. A security element comprising a magnetic layer and an embossed layer characterized in that the magnetic layer is a soft-magnetic layer and in that the soft magnetic layer has, at least partially, the shape of the embossed pattern of the embossed layer, whereby the embossed layer affects the magnetic properties of the soft-magnetic layer.

2. A security element according to claim 1, characterized in that the security element further comprises at least a metal layer with a high specular reflectance.

3. A security element according to anyone of claims 1 or 2, characterized in that the metal layer with a high specular reflectance is chosen from aluminum, silver, chromium, gold or any other highly reflective metal layer or metal oxide such as titanium dioxide, niobium dioxide, tin oxide, indium oxide, indium - tin oxide or zinc oxide.

4. A security element according to anyone of claims 1 to 3, characterized in that the metal layer with a high specular reflectance is aluminum.

5. A security element according to anyone of claims 1 to 4, characterized in that the security element further comprises an adhesive layer.

6. A security element according to anyone of claims 1 to 5, characterized in that the adhesive layer consists essentially of an a,b-ethylenically unsaturated carboxylic acid-based resin.

7. A security element according to anyone of claims 1 to 6, characterized in that the embossed layer comprises an a,b-ethylenically unsaturated carboxylic acid-based resin.

8. A security element according to anyone of claims 1 to 7, characterized in that the diffraction grating device is embossed as to form a hologram.

9. A security element according to anyone of claims 1 to 8, characterized in that the soft magnetic layer consists essentially of an alloy containing cobalt and niobium, together with a glass-forming element.

10.A security element according to anyone of claims 1 to 8, characterized in that the soft magnetic layer consists essentially of an alloy containing cobalt, iron, silicon and boron.

11.A security element according to claim 10, characterized in that said alloy contains further nickel.

12.A security element according to claim 10, characterized in that said alloy has the formula
$Co_a Fe_b Ni_c Mo_d Si_e B_f$, where a is in the range of 35 to 70 atomic percent, b is zero to 8 atomic percent, c is zero to 40 atomic percent, d is zero to 4 atomic percent, e is zero to 30 atomic percent and f is zero to 30 atomic percent, with at least one of the group b, c, d and e, f being non-zero.

13.A security element according to claim 12, characterized in that said alloy has a composition (in atomic percent) in the range :
Co 35-70, Fe 2-7, Ni 10-35, Mo 0-2, Si 12-20 and B 6-12.

14.A security element according to any previous claim, characterized in that the shape of the embossed pattern of the embossed layer is only embossed on a single soft-magnetic layer.

15.A security element according to any previous claim, characterized in that the material of the soft magnetic layer has a coercive force in the range 3 A/m to 500 A/m.

16. A security element according to any previous claim characterized in that the soft-

magnetic layer is a non-work-hardened layer.

17. A security element according to any previous claim, characterized in the soft-magnetic layer is a sputtered layer.

18. A security element according to any previous claim, characterized in that, the affect on the magnetic properties of the soft-magnetic layer is at least a change in coercive force of 10% or a change in relative permeability of at least 10%.

19. A method for producing a security element according to anyone of claim 1 to 18, comprising the steps of :
a) applying a release coating on a polymeric film carrier
b) applying an embossable layer on the polymeric film which is used as carrier,
c) embossing the embossable layer with an diffraction grating pattern such as a hologram, and
d) applying a soft-magnetic layer on the embossed face of the embossed layer, whereby the application step affects the magnetic properties of the soft-magnetic layer.

20. A method for producing a security element according to claim 19, comprising further the step of applying a metal layer with a high specular reflectance under, above or on both sides of the soft-magnetic layer.

21. A method for producing a security element according to claim 19 or 20, comprising further the step of applying an adhesive layer on the top of the different deposited layers.

22. A method for producing a security element according to any of the claims 19 to 21, characterized in that the shape of the embossed pattern of the embossed layer is only embossed on a single soft-magnetic layer.

23.A method for producing a security element according to any of claims 19 or 22, characterized in that the material of the soft magnetic layer has a coercive force in the

range 3 A/m to 500 A/m.

24. A method for producing a security element according to any of the claims 19 to 23 characterized in that the soft-magnetic layer is a non-work hardened layer.

25.A method for producing a security element according to any of the claims 19 to 24, characterized in the soft-magnetic layer is a sputtered layer.

26. A method for producing a security element according to any of the claims 19 to 25, characterized in that, the affect on the magnetic properties of the soft-magnetic layer by the application step is at least a change in coercive force of 10% or a change in relative permeability of at least 10%.

27. A security document having a security element according to anyone of claims 1 to 18.

28. A security document according to claim 28, characterized in that such security document is a bank note, a credit card or a cheque.

29. A security document according to claim 28, characterized in that such security document is a label.

30. A method for the manufacture of a security document having a security element comprising the step of affixing a security element according to anyone of claims 1 to 18 to a substrate.

31. A method according to claim 30 characterized in that the security element is affixed to the substrate on an essentially clear region thereof.

Figure 1

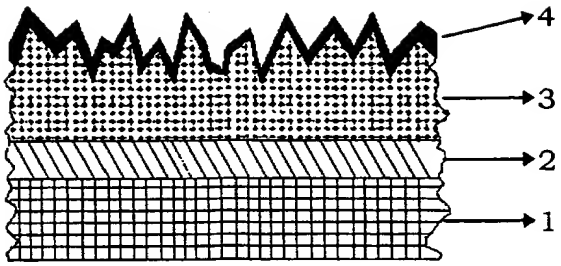


Figure 2

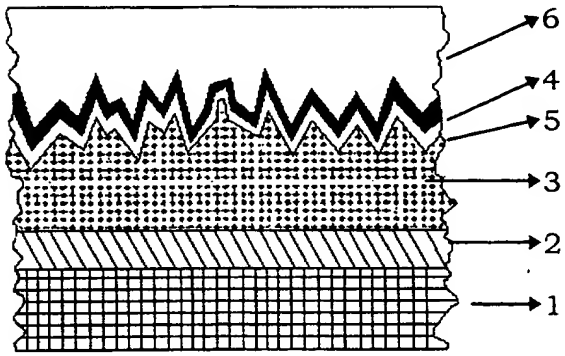
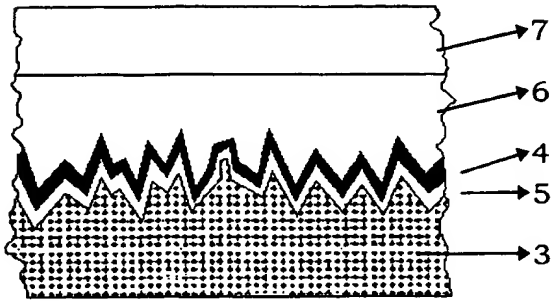


Figure 3



INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/02771

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K19/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 849 618 A (NAMIKAWA) 18 July 1989 (1989-07-18) column 1, line 8 - line 11 column 2, line 67 - column 3, line 13 column 3, line 44 - line 62 column 4, line 26 - line 46	1-5,10, 15,27, 28,30,31
A	column 5, line 8 - line 12 column 7, line 13 - line 25 column 7, line 51 - line 52 column 8, line 63 - column 9, line 11 column 9, line 23 - line 36	9,11
Y	figures 10,11	8,19-23
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
2 September 1999	10/09/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Thomas, R.M.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

I: :ational Application No
PCT/EP 99/02771

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 383 687 A (SUESS) 24 January 1995 (1995-01-24) column 2, line 40 - line 54 column 4, line 36 - line 61 column 5, line 55 - column 6, line 21	8,19-23
A	column 6, last last - column 7, line 45; figure 1 ---	1-3,5, 27,28,31
A	US 5 720 500 A (OKAZAKI) 24 February 1998 (1998-02-24) column 1, line 8 - line 13 column 4, line 21 - line 43 column 5, line 4 - line 15 figure 4 -----	1,5,17, 19,25, 27,28,31

INTERNATIONAL SEARCH REPORT

Information on patent family members

national Application No
PCT/EP 99/02771

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4849618 A	18-07-1989	JP 61248228 A	05-11-1986
US 5383687 A	24-01-1995	AT 139487 T	15-07-1996
		BR 9300682 A	31-08-1993
		DE 4212290 C	27-05-1993
		DE 4242407 A	02-09-1993
		DE 59302961 D	25-07-1996
		DK 559069 T	15-07-1996
		EP 0559069 A	08-09-1993
		ES 2089608 T	01-10-1996
		HK 1003986 A	13-11-1998
		JP 6064375 A	08-03-1994
US 5720500 A	24-02-1998	JP 6278390 A	04-10-1994
		AU 667420 B	21-03-1996
		DE 69417604 D	12-05-1999

US 0967342809P1

Creation date: 03-08-2004
Indexing Officer: TLE8 - TINA LE
Team: OIPEBackFileIndexing
Dossier: 09673428

Legal Date: 10-23-2002

No.	Doccode	Number of pages
1	CTNF	8
2	892	1
3	1449	3
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Total number of pages: 48

Remarks:

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